

DESCRIPTION
TRUNKING SYSTEM CONTROL METHOD

Technical Field

5 The present invention relates to a trunking system control method for use in a radio communication system.

Background Art

10 Regarding a wide frequency bandwidth trunked radio communication system, an analog trunking system using a control channel and a telephone communication channel has been described in Japanese Patent No. 2724917 specification 1. In the analog trunking
15 system according to this Patent Document, when all telephone communication channels are busy, a control channel for communicating control signals is used as a telephone communication channel, whereby all wireless relay channels are assigned as telephone communication
20 channels. However, the above analog trunking system of the Patent Document has the following problems.

 Specifically, when all telephone communication channels are busy, a control channel is used as a telephone communication channel, and thus a state
25 where there exists no control channel temporarily occurs. In such state, a wireless unit accommodated by a wireless relay having a control channel cannot await a control signal. Accordingly, the wireless unit will frequently perform scanning operation, thus
30 increasing current consumption.

A further problem is that when a control channel is switched to a telephone communication channel, in the site using the channel, the trunk operation cannot be performed until the telephone communication by the
5 above channel is completed.

An object of the present invention is to make switching between control channel and telephone communication channel more efficient and to reduce current consumption in a wireless unit and at the same
10 time to reduce the time period for which the trunk operation is inoperative.

Disclosure of the Invention

To achieve the above object of the present
15 invention, a control method for a trunking system is provided according to a first aspect of the present invention, the trunking system performing exchange between a wireless unit and the other communication party by means of control signal communication with
20 the wireless unit by use of a control channel, and thereby allowing communication signal communication using a selected telephone communication channel between the wireless unit and the other communication party. In the control method, there are performed:
25 when all the telephone communication channels are busy when a new request for the telephone communication channel comes from the wireless unit, a telephone communication channel making processing for using the control channel as a telephone communication channel;
30 and when any of the busy telephone communication

channels is released when the control channel is used as a telephone communication channel, a control channel shifting processing for setting the released telephone communication channel as a new control
5 channel, and by using all channels, notifying a plurality of the wireless units that the released telephone communication channel currently acts as a new control channel.

To achieve the above object, a control method
10 for a trunking system is provided according to a second aspect of the present invention, the trunking system performing exchange between a wireless unit and the other communication party by means of control signal communication with the wireless unit by use of
15 a control channel, and thereby allowing communication signal communication using a selected telephone communication channel between the wireless unit and the other communication party. In the control method, there are performed: when all the telephone
20 communication channels are busy when a new request for the telephone communication channel comes from the wireless unit, a telephone communication channel making processing for using the control channel as a telephone communication channel; and when any of the
25 busy telephone communication channels is released when the control channel is used as a telephone communication channel, a control channel shifting processing for causing communication performing transmission/reception to/from the wireless unit by
30 use of the control channel to be shifted to the

released telephone communication channel, and releasing the control channel so as to be able to be used for transmission and reception of the control signal.

5 In the trunking system control method according to the first and second aspects of the present invention, when the control channel is used as a telephone communication channel, a control channel usage state notifying processing is preferably
10 performed which incorporates into a telephone communication signal transmitted/received by use of the control channel, information indicating the availability of the telephone communication channel currently used as the control channel, and performs
15 transmission.

 In the trunking system control method according to the first aspect of the present invention, when all telephone communication channels are busy, the control channel is used as a telephone communication channel.
20 Then when an idle telephone communication channel emerges, the telephone communication channel is used as a control channel. Accordingly, the time period for which there exists no control channel for transmitting/receiving a control signal is shortened,
25 and wireless unit current consumption is reduced and at the same time, the time period for which the trunk operation cannot be performed can be reduced.

 In the trunking system control method according to the second aspect of the present invention, when
30 all telephone communication channels are busy, the

control channel is used as a telephone communication channel. Then when an idle telephone communication channel emerges, a communication signal which has been communicated by use of the control channel is
5 transmitted/received by use of the idle telephone communication channel. Accordingly, the time period for which there exists no control channel for transmitting/receiving a control signal is shortened, and wireless unit current consumption is reduced and
10 at the same time, the time period for which the trunk operation cannot be performed can be reduced.

Brief Description of the Drawings

Figure 1 is a configuration diagram showing a
15 trunking system according to a first embodiment of the present invention;

Figure 2 is a flowchart showing an outline of a usage state notifying processing;

Figure 3 is a view showing a frame format
20 containing a telephone communication signal;

Figure 4 is a sequence diagram of the usage state notifying processing; and

Figure 5 is a flowchart showing a telephone communication channel shifting processing according to
25 a second embodiment of the present invention.

Embodiments of the Invention

Embodiments of the present invention will be described below in detail with reference to the
30 drawings.

[First Embodiment]

Figure 1 is a configuration diagram showing a trunking system according to a first embodiment of the present invention.

5 The trunking system includes a plurality of trunk control apparatuses 10-1, 10-2, ..., and 10-n (n is a natural number of two or more).

 The trunk control apparatuses 10-1 to 10-n are connected to each other via a control bus.

10 Wireless relays 20-2, ..., and 20-n are connected to the trunk control apparatuses 10-1 to 10-n, respectively.

 In the trunking system, control signal communication with a plurality of wireless units 31, 15 32, 33, 34, 35, 36 and 37 is performed using a control channel, whereby exchange between the wireless unit and the other communication party is performed.

 Each of the wireless relays 20-1 to 20-n is an apparatus relaying communication between the wireless 20 units 31, 32, 33, 34, 35, 36 and 37, constituted of a mobile communication unit or the like, and the trunk control apparatuses 10-1, 10-2, ..., and 10-n, and includes a radio transmitter/receiver performing, for example, four value modulation/demodulation, and a 25 voice coder and a voice decoder.

 The wireless relay 20-1 uses channel f1 in communicating with the wireless units 31 to 37. This channel f1 is used as a control channel for transmitting/receiving a control signal, but also used 30 as a telephone communication channel for

transmitting/receiving a telephone communication signal. This channel f1, normally used as a control channel, is registered with the wireless units 31 to 37. The wireless units 31 to 37 scan a control signal
5 by channel f1.

The wireless relays 20-2 to 20-(n- 1) use channels f2 to f(n-1) in communicating with the wireless units 31 to 37, respectively. Channel f2 to f(n-1) are used as telephone communication channels
10 for transmitting/receiving a communication signal.

The wireless relay 20-n uses channel fn in communicating with the wireless units 31 to 37. Similarly to channel f1, channel fn is used as a telephone communication channel for
15 transmitting/receiving a telephone communication signal, but can also be used as a control channel for transmitting/receiving a control signal.

The operation of the trunking system will now be described.

20 When communication between any one of the wireless units 31 to 37 and the other communication party is started, a control signal is transmitted/received between the wireless relay 20-1 and any one of the wireless units 31 to 37. In the
25 control signal communication, channel f1 is used as a control channel. After the communication between the wireless units 31 to 37 and the other communication party is started, channels f2 to f(n-1) or channel fn are selected and used, and telephone communication
30 signals are transmitted/received between the wireless

relays 20-2 to 20-n and the wireless unit 31 to 37,
and thus telephone communication signals are
transmitted/received to/from the other communication
party. In this case, channel fn is used as a
5 telephone communication channel.

When channels f2 to f(n-1) and fn are used as a
telephone communication channel and become busy,
channel f1 of the wireless relay 20-1 is set as a
telephone communication channel, and telephone
10 communication signals are transmitted/received to/from
the wireless relays 31 to 37 by use of channel f1.
Accordingly, even when further facility investment is
not made, the number of available telephone
communication channels is increased. It is noted that
15 the telephone communication channel making processing
of setting channel f1 as a telephone communication
channel is a known technique, and hence a detailed
explanation thereof is omitted here.

When telephone communication signals are
20 transmitted/received by using channel f1 as a
telephone communication channel, when communication
using channel fn of the wireless relay 20-n is
completed, this is detected by the trunk control
apparatuses 10-1 to 10-n, and channel fn will be used
25 as a control channel. More specifically, information
such that channel fn will be used as a control channel
from now on, is notified to the wireless units 31 to
37 by use of all channels f1 to fn. The wireless
units 31 to 37 hold this information, and use channel
30 fn as a control channel instead of channel f1 until

subsequent information is supplied. Accordingly, starting just after channel fn is released, the trunk operation based on a control signal becomes possible.

When channel f1 which has been used as a control
5 channel until then, is used as a telephone
communication channel, the trunk control apparatus 20-
1 inserts in an overlapped manner into information
transmitted via the downlink communication of channel
f1, information indicating the usage state of channel
10 fn acting as a control channel and the usage state of
neighboring channels, and thereby notifies the
information to the wireless unit currently making a
telephone call. When such usage state notifying
processing is performed, the wireless unit which has
15 been using channel f1 can perform quick switching to
another channel. An outline of the usage state
notifying processing will be described with reference
to Figures 2 to 4.

Figure 2 is a flowchart showing an outline of
20 the usage state notifying processing. Figure 3 is a
view showing a frame format containing a telephone
communication signal. Figure 4 is a sequence diagram
of the usage state notifying processing.

The trunk control apparatus 10-1 receives from
25 the wireless relay 20-1 a frame containing a telephone
communication signal (step ST1).

In transmitting downward a telephone
communication signal to the wireless units 31 to 37,
the transmit frame is constituted of a sync frame, an
30 additional information frame and audio frames as shown.

in Figure 3. The trunk control apparatus 10-1 determines whether or not it is an update timing of the usage state of the control channel fn and neighboring channels. If it is not an update timing (step ST2: NO), normal information is set in the additional information frame (step ST3).

If it is an update timing of the usage state of the control channel fn and neighboring channels (step ST2: YES), the trunk control apparatus 10-1 acquires the usage state of the control channel fn and neighboring channels via the other trunk control apparatuses 10-2 to 10-N (step ST4).

The trunk control apparatus 10-1 determines whether or not channel fn is busy and if not so (step ST5: NO), performs step ST3. If channel fn is busy (step ST5: YES), the trunk control apparatus 10-1 determines whether or not channel fn is currently used as a control channel (step ST6).

If channel fn is not currently used as a control channel (step ST6: NO), the trunk control apparatus 10-1 performs step ST3. If channel fn is currently used as a control channel (step ST6: YES), the trunk control apparatus 10-1 sets into the additional information of the transmit frame, information indicating the usage state of the control channel and the usage state of the neighboring channels (step ST7).

At the time when step ST3 or step ST7 is completed, the trunk control apparatus 10-1 transmits the transmit frame from the wireless relay 20-1 to the wireless unit (the wireless unit to be communicated

with) currently using channel f1 (step ST8).

When steps ST1 to ST8 are repeated, the usage state of channel fn acting as a control channel and the usage state of the neighboring channels are periodically supplied to the wireless unit to be communicated with, as shown in Figure 4.

As described above, according to the present embodiment, channel f1 which has been used as a control channel, is used as a telephone communication channel, and when channel fn is released, this channel fn is set as a control channel. Accordingly, a state in which there exists no control channel is prevented from continuing long, thus allowing reduction of wasted current consumption in the wireless units 31 to 37 and at the same time allowing shortening of the time period for which the trunk operation cannot be performed.

[Second Embodiment]

According to the above first embodiment, channel f1 which has been used as a control channel, is used as a telephone communication channel, and when channel fn is released, this channel fn is fixedly set as a control channel.

According to this second embodiment, when channel f1 is used as a telephone communication channel, a telephone communication channel shifting processing is performed, whereby the telephone communication channel is shifted to channel fn, and the control channel is again returned to channel f1 (refer to Figure 5).

Figure 5 is a flowchart showing a telephone communication channel shifting processing according to the second embodiment of the present invention.

In a state in which all telephone communication channels are busy, channel f1 which has been a control channel until then, is changed to a telephone communication channel, and channel f1 performs transmission/reception of telephone communication signals. When detecting via the trunk control apparatus 10-n that channel fn has been released, the trunk control apparatus 10-1 performs the following steps ST11 to ST16.

Firstly the trunk control apparatus 10-1 collects the state of channel f1 (step ST11) and determines whether or not channel f1 is busy (step ST12). If channel f1 is not busy (step ST12: NO), the use of channel f1 is stopped (step ST13). Specifically, its use as a telephone communication channel is stopped.

If channel f1 is busy (step ST12: YES), it is determined in step ST14 whether or not channel f1 has been used as a control channel. If so (step ST14: YES), the use of channel f1 as a telephone communication channel is stopped (step ST15).

If channel f1 has not been used as a control channel (step ST14: NO), the trunk control apparatus 10-1 performs shifting from communication using channel f1 to communication using channel fn (step ST16).

After the processing of step ST15 or step ST16,

the trunk control apparatus 10-1 sets channel f1 as a control channel for transmitting/receiving a control channel (step ST17).

5 As described above, according to the present embodiment, when channel fn is released, communication which has been using channel f1 as a telephone communication channel is shifted to channel f2, and channel f1 is again restored to a control channel. Accordingly, when channel fn is released, there exists
10 again a control channel, whereby a state in which there exists no control channel is prevented from continuing long. Therefore, wasted current consumption in the wireless units 31 to 37 can be reduced and at the same time the time period for which
15 the trunk operation cannot be performed can be shortened.

Industrial Applicability

20 A radio communication trunking system can be implemented which can reduce consumption current in accommodated wireless units and at the same time can significantly shorten the time period for which the trunk operation cannot be performed, and the system can be used in wide band radio communication networks.